UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

# ZGE 371/3 – Potential Field Interpretation
## *[Pentafsiran Medan Keupayaan]*

Duration : 3 hours
*[Masa : 3 jam]*

Please ensure that this examination paper contains **FIVE** printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

**Instruction**: Answer **ANY FOUR (4)** questions only. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab **MANA-MANA EMPAT (4)** soalan sahaja. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

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1. (a) Discuss the direct and inverse problem in geophysical interpretation.
*[Bandingkan masalah terus dan masalah songsang dalam tafsiran geofizik.]*
(30/100)

(b) From the gravity field potential equation
*[Daripada persamaan medan keupayaan gravity]*

$$U = G\rho \iiint \frac{1}{R} dV \qquad \text{Eq. (1)}$$

(i) Show that the gravity vertical component, $g_z$, is given as
*[Buktikan bahawa komponen tegak anomali graviti, $g_z$, diberikan oleh]*

$$g_z = G\rho \iiint \frac{z}{R^3} dV$$

(ii) From equation (1), show that the gravity field potential for 2-dimension is given as
*[Daripada persamaan (1), juga buktikan bahawa medan keupayaan graviti bagi jasad dua dimensi ialah]*

$$U = 2G\rho \iiint \ell nR dx dz$$

and show that the vertical gravity component for two-dimension is
*[dan juga buktikan bahawa komponen tegak anomali graviti jasad dua dimensi ialah]*

$$g_z = 2G\rho \iint \frac{z}{R^2} dx dz \qquad \text{Eq. (2)}$$

(iii) Show that equation (2) can be written as
*[Buktikan bahawa pers. (2) boleh ditulis semula sebagai]*

$$g_z = 2G\rho \oint z d\theta$$

(70/100)

...3/-

2. (a) From the magnetic field potential equation
*[Daripada persamaan medan keupayaan magnet]*

$$A = -\iiint_v \bar{\mu}_o \bullet \nabla\left(\frac{1}{R}\right) dV$$

(i) Show that the vertical component of the magnetic field is
*[Buktikan bahawa komponen tegak medan magnet ialah]*

$$H_v = I \iiint \frac{\partial}{\partial z}\left(L\frac{\partial}{\partial x} + M\frac{\partial}{\partial y} + N\frac{\partial}{\partial z}\right)\left(\frac{1}{R}\right) dV$$

(ii) Show that $H_v$ for two-dimension is
*[Juga buktikan bahawa $H_v$ bagi jasad dua dimensi ialah]*

$$H_v = 2I \iint_s \frac{\partial}{\partial z}\left(L\frac{\partial}{\partial x} + N\frac{\partial}{\partial z}\right)(\ell nR) dS$$

(iii) Show that the equation for $H_v$ in (ii) can be written as
*[Buktikan bahawa persamaan bagi $H_v$ di bahagian (ii) juga boleh ditulis sebagai]*

$$Hv = 2I\left(1 - \cos^2 \nu \cos^2 \lambda\right)^{\frac{1}{2}} \oint \frac{x\sin\beta - z\cos\beta}{x^2 + z^2} dz$$

(70/100)

(b) Explain linear and nonlinear problems. Give examples.
*[Apakah masalah linear dan taklinear. Beri contoh.]*

(30/100)

...4/-

3. (a) Write an essay about least square nonlinear optimization method.
*[Tuliskan karangan tentang kaedah pengoptimuman taklinear kuasa dua terkecil.]*

(60/100)

(b) Let the error function be
*[Andaikan fungsi ralat yang diberi oleh]*

$$E(\bar{x}) = 4x_1^2x_2^2 + (x_2^2 - 4)^2$$

Beginning with the initial point (1,1), find the new point after one iteration.
*[Dengan bermula daripada titik awal (1,1) carikan titik yang baru selepas satu lelaran. ]*

(40/100)

4. (a) Write an essay about steepest descent nonlinear optimization method.
*[Tuliskan karangan tentang kaedah pengoptimuman taklinaer penurunan tercuram.]*

(60/100)

(b) Let the error function with two variables is given by
*[Andaikan fungsi ralat dengan dua pembolehubah yang diberikan oleh ]*

$$E(\bar{x}) = (x_1 - 3)^2 + 3(x_2 - 4)^2$$

Using the steepest descent method of nonlinear optimization, find the minimum point after one iteration if the initial point $\bar{x}_0$ is (2,3).
*[Dengan menggunakan kaedah penurunan tercuram, cari anggaran bagi titik minimum selepas satu lelaran kalau titik awal $\bar{x}_0$ ialah (2,3).]*

(40/100)

...5/-

5. For a n-layer earth model, the general solution for the Laplace equation for electrical potential due to point source DC current I introduce into the surface of the model is given as
*[Untuk model bumi n-lapisan, penyelesaian am kepada persamaan Laplace bagi keupayaan elektrik yang diakibatkan oleh suatu sumber titik arus terus I yang dimasukkan pada permukaan model ialah]*

$$V_i = \frac{\rho_i I}{2\pi}\int_0^\infty \left[e^{-\lambda z} + \theta_i(\lambda)e^{-\lambda z} + X_i(\lambda)e^{\lambda z}\right]J_o(\lambda r)d\lambda$$

where the symbols bring the usual meanings.
*[di mana simbol-simbolnya membawa maksud biasa.]*

(a) Explain the parameters in the above equation
*[Jelaskan semua parameter dalam persamaan di atas]*

(20/100)

(b) Discuss all the five boundaries for this case
*[Bincangkan kelima-lima syarat sempadan yang harus dipenuhi untuk kes ini].*

(50/100)

(c) Show that at the surface V can be written as
*[Tunjukkan bahawa di permukaan tanah V boleh ditulis sebagai]*

$$V_i = \frac{\rho_i I}{2\pi}\int_0^\infty \left[1 + 2\theta_i(\lambda)\right]J_o(\lambda r)d\lambda$$

(30/100)

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